THE DAYLIGHT BOMBING OF NAZI EUROPE BY

U.S.A.A.F.™

UNITED STATES ARMY AIR FORCE

SSI™

STRATEGIC SIMULATIONS, INC.

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1.0 INTRODUCTION

U.S.A.A.F. is a simulation of the daylight strategic bombing offensive against the Third Reich in World War II. The game covers the period from August 1943 to the end of the war.

1.1 Starting a Game (Apple)

To begin the game, boot side one and the game will begin automatically. If you are using an Apple III you must first go into Apple II emulation mode. After you have selected a scenario the computer will instruct you to insert side two of the disk for the remainder of the game.

1.2 Starting a Game (C-64)

To begin the game, insert the game disk into your disk drive. Type: LOAD"*",8 and press <RETURN>. When READY appears, type RUN and press <RETURN>.

1.3 Starting a Game (Atari)

To begin, boot the Scenario side of your disk. Before beginning remove all cartridges from your computer. Owners of the 800XL will have to hold down the OPTION key when they turn on their computer to boot the game. After you have selected the starting conditions for the game, the computer will ask you to insert the Game side of your disk.

1.4 Saving a Game

At various points during each turn the computer will allow the player(s) to save a game in progress. You will need a scratch disk to store the save game data. Save game disks may be initialized for SSI use during a game by following instructions included in the game program. Each save game disk will hold approximately 6 games. Once a game is saved you will be able to restart it at the point you left off.

1.5 Sound

During the Combat Phase the players may toggle the sound ON/OFF by pressing the (O) key. The new sound status will take effect when the game clock display is updated.

2.0 GENERAL DESCRIPTION

2.1 Parts Inventory

A. Game box
B. Rules manual
C. 5¼" game disk
D. 2 player aid cards

2.2 The Map

The game map displays England and Nazi-occupied Europe including the area from France in the west to Rumania in the east and from Denmark in the north to Italy in the south. A 48 × 32 square grid is used to control movement. Each square is 33 miles across.

Terrain features on the map include American Flag symbols that represent USAAF bases; blue areas represent seas and oceans; black areas represent open land; green 'x' symbols represent Luftwaffe airfield sites; white 'x' symbols represent active Luftwaffe airfields (displayed only to the Luftwaffe player); orange areas represent Axis cities; white striped areas represent neutral Switzerland.

2.3 Definition of Terms

ACTIVE AIRFIELD
A Luftwaffe airfield site that includes the necessary personnel and equipment to effectively repair, fuel and arm fighter aircraft.

AIRFIELD SITE
Squares on the map that are eligible to contain active airfields. There are over 100 airfield sites on the map and only 48 may be 'active' at any one time.

ALTITUDE
The elevation in thousands of feet that a raid or patrol is assigned to fly in performing its mission.

DAMAGE
Individual target damage is displayed when reviewing a previous day's operations. This number reflects the percentage loss in production of an industrial target, percentage loss in guns for a flak target, or percentage loss in operating capability for airfield targets. For scoring purposes, an overall damage level is displayed on the Morning Briefing menu. This number represents the cumulative effects of strategic bombing on the German war effort.

EXPERIENCE
A measure of the average amount of flying or combat experience of the pilots in a Group/Gruppe. Numbers range from 0 (no experience) to over 100 (very experienced).

FEINT
A USAAF mission undertaken for the purpose of deceiving the Luftwaffe into committing fighters needlessly.

FLAK
Up to 200 heavy and 200 light flak batteries may be used to defend target cities. Heavy flak is effective against aircraft flying below 30,000 feet; light flak is effective against aircraft flying below 6,000 feet.

GROUP
The basic USAAF organizational unit used in the game. Bomber groups contain up to 48 aircraft (usually no more than 37). Fighter groups contain up to 55 aircraft.

GRUPPE
The basic Luftwaffe organizational unit used in the game. Gruppes contain up to 50 aircraft.

MORALE
A measure of the spirit and dedication of the pilots and crews of a Group/Gruppe. Values range from 20 (demoralized) to over 100 (hungry for action). Morale is reduced by flying and may be increased by resting.

RANDOM NUMBER
A number randomly determined that is greater than or equal to 0 and less than 1.

ROCKETS
Air-to-air rockets were used primarily to disrupt heavy bomber formations. Aircraft armed with rockets suffered from greatly reduced manueverability and were 'dead meat' when opposed by Allied fighters.

SERVICEABLE AIRCRAFT
The number of aircraft in a Group/Gruppe available for immediate operations. Aircraft may become unserviceable (unavailable) due to battle damage or normal wear and tear from just flying.

TIME
The passage of time is displayed on a 24-hour game clock during the combat phase. At the start of each day, the clock will begin at 520 and will increment in 10-minute pulses until all USAAF raids have been completed. Raids landing at night (after 1700) will suffer higher operational losses.

WEATHER
Weather in the game is expressed as a percentage of overcast or cloud cover. Cloud cover may adversely affect the ability of bombers to locate or accurately bomb their targets. Weather will adversely affect the ability of fighters to locate targets for air-to-air combat. Aircraft taking off or landing in poor weather will suffer higher operational losses and USAAF raids forming up in poor weather may be forced to abort their missions. During short game scenarios the overcast levels will be reduced by an average of 20%.

WEATHER ZONES
There are 6 different weather zones on the map: northwest, north-central, northeast, southwest, south-central, and southeast. Cloud cover is specifically defined for each weather zone. On the average, cloud cover in the southwest and south-central zones will be 20% less than the other zones on the map. Flying conditions will be best during the summer months, average during the spring and fall months, and poorest during the winter months.

3.0 STARTING THE GAME

3.1 Determining Conditions of Play

At the start of the game, the player(s) must determine the conditions under which the game must be played. On the APPLE® version the conditions may be changed by entering the following numbers:

(1) NEW GAME or SAVED GAME
(2) 1 DISK DRIVE or 2 DISK DRIVES
(3) SOLITAIRE or TWO PLAYERS
(4) HANDICAP LEVEL
(5) DELAY LENGTH
(6) SELECT SCENARIO

On the ATARI® and COMMODORE 64™ versions:

(1) NEW GAME or SAVED GAME
(2) SOLITAIRE or TWO PLAYERS
(3) HANDICAP LEVEL
(4) DELAY LENGTH
(5) SELECT SCENARIO

3.2 Player Determination

U.S.A.A.F. may be played by zero, one or two players, and this is determined by the option selected on the opening menu. For example, if you wish to watch a computer controlled USAAF face a computer controlled Luftwaffe, you should select the option BOTH COMPUTER.

3.3 Handicap Level

At the start of the game the player(s) must determine the handicap level (1-5). The effects of the handicap level are such that LEVEL 1 would significantly favor the USAAF player and LEVEL 5 will significantly favor the Luftwaffe player. LEVEL 3 is the historical level.

Handicap level will affect the USAAF replacement rate, the ability of Allied Intelligence to determine 'critical' targets and the ability of the Axis war industry to accelerate the development of advanced aircraft types (such as the ME262A jet fighter).

3.4 Delay Length

The delay length affects messages displayed during the Combat Phase. The greater the delay length, the longer these messages will remain displayed. A delay length of 1 will speed up the game but will cause the messages to be difficult to read. A delay length of 9 will slow the game considerably but will allow the player(s) maximum time to study the various combat reports.

3.5 Selecting a Scenario

The players may select from three different time periods in which to start the game:

PHASE I (1 AUGUST 1943)
PHASE II (1 FEBRUARY 1944)
PHASE III (1 OCTOBER 1944)

It is strongly suggested that beginning players start with a Phase II game.

In addition to selecting the time period, the player(s) may elect to play either a Short Game or a Campaign Game. The Short Game will end after one month. The Campaign Game will end when the Axis Industrial Damage Level exceeds 99 or on 1 August 1945, whichever comes first. The SHORT or CAMPAIGN decision is not made from the opening menu; it is made after the initial data has been read from the disk.

4.0 SEQUENCE OF PLAY

Each game turn represents one day of real time. The game turn is divided into 6 phases in which the player(s) may review intelligence reports and then plan and execute their daily missions. On the first turn of each new game, the Luftwaffe morning briefing phase is skipped.

4.1 Luftwaffe Morning Briefing*

The Luftwaffe player may: (1) review the results of the previous day's operations, (2) check the weather forecast, (3) inspect the status of his fighter gruppes, (4) inspect the status of the German war industries, (5) check the numbers of aircraft available in the replacement pools, (6) change the types of aircraft being produced in aircraft factories, (7) review the production status for each type of aircraft.

4.2 USAAF Morning Briefing

The USAAF player may: (1) review the results of the previous day's operations, (2) check the weather forecast, (3) inspect the status of his bomber and fighter groups at each of his bases, (4) inspect the status of the German war industries.

4.3 USAAF Target Assignment*

The USAAF player may: (1) assign bomber and fighter groups to fly raids over Axis Europe, (2) examine data from previously assigned raids with the option of canceling unsatisfactory raids, (3) check the weather forecast, (4) examine the map display.

4.4 Luftwaffe Deployment*

The Luftwaffe player may: (1) review the status of his fighter gruppes, (2) review the status of his active airfields, (3) check the number of heavy and light flak batteries protecting each of his cities, (4) check the weather report, (5) assign tactics to his fighter gruppes, (6) move fighter gruppes to different active airfields, (7) move active airfields to a different airfield site, (8) move flak batteries to protect different cities.

4.5 Combat Phase – Luftwaffe Situation Room

The Luftwaffe player may: (1) alter the map display to view different portions of the map, (2) review the size and altitude of any USAAF raids that have been detected, (3) go to the Luftwaffe Situation Room.

From the Situation Room the Luftwaffe player may: (1) review the status of his uncommited fighter gruppes, (2) check the status of his active airfields, (3) inspect the flak batteries in each of his cities, (4) check the weather report, (5) assign fighter gruppes to intercept USAAF raids, (6) assign fighter gruppes to fly patrols over particular areas, (7) instruct fighter patrols to intercept USAAF raids or change their patrol locations, (8) resume the Combat Phase.

4.6 Overnight Activity Phase

During this phase the computer will automatically perform various bookkeeping functions such as repairing damage, assigning replacements, calculating the score, etc.

5.0 LUFTWAFFE MORNING BRIEFING

5.1 Yesterday's Operations

For each raid flown the previous day the computer will list:

(1) TARGET; if the target was a city then the city name will appear, otherwise AIRFIELD, FLAK, FEINT or DEEP ESCORT will be shown
(2) BG; number of USAAF bomber groups included in the raid
(3) BL; USAAF bombers lost due to air-to-air combat or flak
(4) FG; number of USAAF fighter groups included in the raid
(5) FL; USAAF fighters lost due to air-to-air combat or flak
(6) IG; the number of times the raid was 'intercepted' by Luftwaffe fighter groups
(7) IL; the number of intercepting Luftwaffe fighters destroyed in air-to-air combat
(8) TD; target damage percentage
(9) C; class code of target (A-L) will be shown for city targets to indicate the type of target bombed within that city:

A railyard (Overlord)
B ball bearings
C chemicals
D oil
E aviation gas
F electric power
G steel
H rubber
I U-boat
J armaments
K aircraft
L V-weapon

USAAF losses shown on this display may be inaccurately reported (usually higher than actual losses).

5.2 Weather Report

Lists the predicted cloud cover for each of the six weather zones on the map.

5.3 Air Group Status

Lists the following data for each available Luftwaffe fighter gruppe:

(1) ID; gruppe identification number
(2) GROUP; the historical gruppe designation
(3) AS; aircraft serviceable
(4) AU; aircraft unserviceable
(5) EX; experience rating
(6) MO; morale rating
(7) TYPE; type of aircraft used by the gruppe
(8) the gruppe's airfield ID number will be displayed at the right edge of the screen

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* indicates the game may be saved following this phase

5.4 Industry Status
The Luftwaffe player may inspect the status for each type of industry. For each city containing the selected industry the computer will display the city ID number, city name and production level for that city. A total industry level will be displayed at the bottom of the list. The number to the right of the slash is the unadjusted industry level. The number to the left is the industry level adjusted for critical industry damage (except for the aircraft industry). The adjusted levels will be set to 100 at the beginning of each game.

5.5 Replacement Aircraft
The player may inspect the number of replacements for each type of aircraft. For each type of aircraft available the computer will display the type ID number, type designation and the quantity of aircraft available as replacements.

The Replacement Aircraft routine may be used to change the type of aircraft being used by a particular gruppe. This is done by 'exchanging' the aircraft currently used by the gruppe for a different aircraft type available in the replacement pool. The USAAF player may not exchange fighters for bombers or bombers for fighters.

Type in the gruppe ID# for the gruppe you wish to change, then enter the type ID# to indicate the new type of aircraft. The 'old' aircraft will be added to those of the same type already in the replacement pool. The 'new' aircraft will be subtracted from the replacement pool and added to the exchanging gruppe in UNSERVICEABLE condition. The exchange transaction will not be allowed if the replacement pool does not contain adequate numbers of the selected type to allow a 1 for 1 exchange.

The exchange procedure will result in a reduction of pilot experience. When exchanging for aircraft of the same class (i.e. single engine for single engine), there will be a loss of 20% of the group's experience points. When exchanging for aircraft of a different class (i.e. single engine for twin engine), there will be a loss of 50% of the group's experience points.

5.6 Aircraft Production
The Aircraft Production routine may be used to examine or alter the types of aircraft being produced in a particular city. The computer will display all cities that include aircraft factories. The player must enter the city ID# for the city he wishes to examine/alter.

Aircraft cities contain three production 'slots'. Each slot will contain an aircraft type or will be empty. Aircraft cities with only one slot in use will devote their entire production to that one type of aircraft. Aircraft cities with two slots in use will devote half of their production to each of the two listed types of aircraft. Aircraft cities with all three slots in use will devote one third of their production to each of the three listed types of aircraft.

The Aircraft Production routine may be used to add a new type of aircraft to an empty slot, remove an aircraft type to create an empty slot or change an occupied slot to a different type of aircraft. The player must enter the type ID number for the 'new' aircraft type and the slot number that is to be altered. Aircraft type ID numbers are listed in section 12.0. If you wish to remove an aircraft type to create an empty slot, just enter aircraft type number '0' for a currently occupied slot.

Altering the production of an aircraft city will reduce the aircraft production level of that city. The production level reduction will be determined as follows:

(1) 60% reduction if subtracting an aircraft type to create an empty slot

(2) 20% reduction if adding an aircraft type to fill an empty slot

(3) 20% reduction if changing an occupied slot to a similar aircraft type (i.e. ME109G changed to ME109K)
Note: FW190A, FW190D, FW190F and TA152H are considered to be similar aircraft types.

(4) 60% reduction if changing an occupied slot to a non-similar aircraft type

You cannot change the production characteristics of a city if the city has a production level less than 5.

5.7 Aircraft Factories
The player must select the aircraft type. The computer will display each city involved in the production of that aircraft type and the production level devoted to that type.

6.0 USAAF MORNING BRIEFING

6.1 Yesterday's Operations
Similar to that described in section 5.1. On this display the Luftwaffe fighter losses will be inaccurately reported.

6.2 Weather Report
Same as that described in section 5.2.

6.3 Air Group Status
Similar to that described in section 5.3. The player must first specify the base (England, Italy, Tunisia, Libya) whose groups he wishes to examine.

6.4 Industry Status
Same as that described in section 5.4.

6.5 Replacement Aircraft
Same as that described in section 5.5.

7.0 USAAF TARGET ASSIGNMENT

7.1 Assign Raid
For each raid assigned the USAAF player must perform the following actions:

(1) select raid ID letter (A-Z)

(2) select origin base; the player must determine the base from which the raid will begin. Before 1 OCTOBER 1943, England, Tunisia or Libya may be selected. After 30 SEPTEMBER 1943, England or Italy may be selected.

(3) select target type; the following types of targets or missions may be selected:

A railyard
B ball bearings
C chemicals
D oil
E aviation gas
F electric power
G steel
H rubber
I U-boat
J armaments
K aircraft
L V-weapon
M Overlord
N flak
O airfield
P feint
Q deep escort

(4A) select target city; the computer will list all cities that contain the selected target type. The player must choose the city to be bombed. This applies only to target types A-M.

(4B) select target point; the map will be displayed with the cursor over the starting base. The player must move the cursor over the target to be bombed and press the (X) key. If the target type is FLAK then the cursor should be placed over a city square. If the target type is AIRFIELD, then the cursor should be placed over an airfield site square. If the target type is FEINT, then the cursor may be placed anywhere. This paragraph applies only to target types N,O,P.

(5) select secondary target city; secondary target type must be the same as the primary target. Selection of secondary targets is optional. This paragraph applies only to target types A-M.

(6) select offset point; the computer will display the map with the cursor over the primary target location. Move the cursor to the desired offset point and press the (X) key. The raid will fly through the offset point on the way to the target and again while returning to its base. If the raid bombed a secondary target or if it is shuttling to a different base, then it will not fly through the offset point AFTER it has bombed or passed through the target point. If an offset point is not desired, then press the (X) key without moving the cursor from the target square. Applies to target types A-P.

(7) shuttle to different base; only heavy bombers (B17F, B17G, B24D, B24J) may fly to a base that is different than the origin base.

(8) select bomber type and assign bomber groups; the player may include as many of his available groups as he wishes in a single raid. Different types of bombers may be combined in the same raid. Heavy bombers may not fly in flak attack or deep escort raids. A group (fighter or bomber) must have at least 10 serviceable aircraft in order to fly a mission.

(9) select fighter type and assign fighter groups; fighter groups that fly in the same raid as bomber groups will act as 'close escort' protection against enemy fighters. Fighter groups in deep escort missions are not required to depart at the same time as the bomber raid they are escorting. Deep escorts may join up with the bombers at various points on the route to or from the target. Fighter groups may be used to bomb AIRFIELD, FLAK, and RAILYARD (OVERLORD) targets. Fighter groups will not bomb if they are flying in the same raid with heavy bomber groups. When acting as bombers, fighter groups will fly to the target at their assigned altitude, dive to 1000 feet to attack the target, then climb back to the assigned altitude for the return to base.

(10) determine which raid to escort; this applies only to deep escort missions.

(11) assign raid altitude; the computer will display the altitude limits for each raid. Raids on AIRFIELD, FLAK, and RAILYARD (OVERLORD) targets may not fly over 24000 feet. For the best results, deep escorts should fly 1 to 3 thousand feet above the raid they are escorting.

(12) set departure time; may set any time from 600 to 1700 as departure time. Deep escorts may not depart BEFORE the raid they are escorting.

7.2 Examine Raid

This routine may be used to examine data from previously assigned raids. Included in the raid data display is the range to target (including offset point), raid speed and climb rate.

7.3 Weather Report

Same as that described in section 5.2.

7.4 Map Display

The map display may be used as an aid in planning raids. The cursor may be moved around the map by pressing keys 1-8 (1 = NORTH, 2 = NE, 3 = EAST, 4 = SE, 5 = SOUTH, 6 = SW, 7 = WEST, 8 = NW). If the cursor is moved over a city square and the (L) key is pressed then the city name will be displayed.

8.0 LUFTWAFFE DEPLOYMENT

8.1 Fighter Gruppe Status

Same as that described in section 5.3.

8.2 Airfield Status

Lists the following data for each active airfield:

(1) AF; airfield identification number
(2) LOC; the x,y location of the airfield
(3) D%; damage percentage, airfields with over 49% damage may not operate aircraft.
(4) FR; fuel reserve points stored at the airfield. Each fuel reserve point is sufficient to fly 1 aircraft on 1 sortie.
(5) GRUPPE & TYPE; lists the historical designation and type of aircraft for each gruppe based at the airfield.

8.3 Flak Status

For following data will be displayed for each city on the map:

(1) ID; city identification number
(2) CITY; the city name
(3) HVY FLAK; the number of heavy flak batteries protecting the city
(4) LT FLAK; the number of light flak batteries protecting the city

8.4 Weather Report

Same as that described in section 5.2.

8.5 Assign Fighter Tactics

Each day, the Luftwaffe player may alter the 'tactics' assigned to some or all of his gruppes. The five tactical options are described below:

(1) ATTACK FIGHTER - BOUNCE
The gruppe will attempt to engage USAAF fighter groups but will not attack unless a positional advantage can be attained. Will engage bombers if no fighters are present.

(2) ATTACK FIGHTERS - DIRECT
The gruppe will attempt to engage USAAF fighters and will attack regardless of the tactical position. Will engage bombers if no fighters are present.

(3) ATTACK BOMBERS - BOUNCE
The gruppe will attempt to engage USAAF bombers but will only attack if a positional advantage can be attained. Will NOT engage fighters.

(4) ATTACK BOMBERS - DIRECT
The gruppe will attempt to engage USAAF bombers and will attack regardless of the tactical position. Will NOT engage fighters.

(5) ATTACK BOMBERS - ROCKET
The gruppe will attempt to engage USAAF bombers. Will not attack unless the proper rocket launch position can be attained. Following a rocket launch, the gruppe will engage the bombers with cannon fire. Will NOT engage fighters.

There are two methods for assigning tactics. The DEFAULT TACTICS method allows a tactic to be assigned to all gruppes with a particular type of aircraft. The SPECIFIC GRUPPE TACTICS method allows tactics to be assigned to individual gruppes as desired.

8.6 Move Fighter Gruppe

This routine may be used to move gruppes to different active airfields. The player must input the ID numbers for the gaining and losing airfields and then the ID numbers of the gruppes to be moved. Gruppes will lose 5% of their morale each time they are moved in this manner. The MOVE AIRFIELD routine contains an alternate (and easier) method of moving fighter gruppes.

8.7 Move Airfield

This routine may be used to move active airfields to vacant airfield sites or move fighter gruppes to different active airfields.

(1) move airfield; move the cursor on the map display to the active airfield you wish to move. Press the (G) key to 'get' the airfield. Move the cursor to the new airfield site and press (M) to move the airfield. The airfield move procedure will result in 90% damage to the relocated airfield. Airfields may not be moved to sites that are currently occupied by active airfields.

(2) move gruppe; move the cursor on the map display to an active airfield. The airfield ID number displayed at the bottom of the text window will be inversed if the airfield contains one or more fighter gruppes. Press the (L) key to 'look' at the first gruppe. If you do not wish to move the gruppe then press the (N) key to look at the 'next' gruppe or the (Q) key to return to the map menu. If you wish to move the gruppe you are looking at then move the cursor to the desired active airfield and press (M) to move the gruppe. Gruppes moved in this manner will have their morale reduced by 5%.

8.8 Move Flak

This routine may be used to move flak to enhance protection of key cities. Move the cursor to the 'losing' city and press (T), move the cursor to the 'gaining' city and press (X), then specify the quanties of heavy and light flak you wish to move. A maximum of 100 flak batteries may be moved in a single day.

9.0 LUFTWAFFE SITUATION ROOM

The Luftwaffe player may 'enter' the Situation Room by pressing the (S) key during the Combat Phase. In the Situation Room the real time game clock is frozen while the Luftwaffe player examines his available forces and orders his various gruppes to intercept detected raids or patrol areas where activity is expected.

9.1 Fighter Gruppe Status

Similar to that described in 5.3. Gruppes that are flying patrols or intercept missions will not be displayed.

9.2 Airfield Status

Similar to that described in 8.2. Gruppes that are flying patrols or intercept missions will not be displayed.

9.3 Flak Status

Same as that described in 8.3.

9.4 Weather Report
Same as that described in 5.2.

9.5 Intercept Raid
The detected raids will have their ID letters displayed. To examine a raid, press the key corresponding to the raid's ID. The cursor will move to the raid's location and the estimated raid size and altitude will be displayed.

To intercept the raid, move the cursor to a nearby active airfield. The computer will display the airfield (AF) identification number and the fuel reserves (FR) stored there. If one or more gruppes are located at the base then the display will show the gruppe ID number, historical designation, number of serviceable aircraft, type of aircraft, experience and morale ratings for the first gruppe.

If you do NOT wish to assign the displayed gruppe to intercept then press the (N) key to view the next gruppe or the (Q) key to return to the main menu.

Type the (A) key to assign the displayed gruppe to intercept the raid. It is possible to assign more than one gruppe from the same airfield to fly in the same mission. Gruppes flying intercept missions will have the option of returning to a different airfield. To select a different return airfield move the cursor to the desired location and press (X).

9.6 Establish Patrol
Gruppes are assigned to patrol missions in the same manner that they are assigned to intercept missions. Press the (A) key to assign the gruppe to a patrol mission. Move the cursor to the desired 'patrol area' and press the (X) key. The patrol altitude must be set and the gruppe may be ordered to return to a different base.

9.7 Patrol Adjust
The status of previously assigned patrols may be changed using the Patrol Adjust routine. The location and fuel status of the existing patrols will be displayed one at a time.

If you do NOT wish to adjust the displayed patrol then press the (N) key to locate the next patrol or the (Q) key to return to the main menu.

By pressing the (A) key the player may change the patrol area, altitude and return base.

By pressing the (I) key the patrol may be ordered to intercept a detected raid.

9.8 Luftwaffe Fuel Usage
When fighter gruppes are assigned to fly intercept or patrol missions, then 1 fuel point will be subtracted from the airfield fuel reserve for each serviceable aircraft in the assigned group. If there are more flying aircraft than fuel reserve points, then the fuel will be reduced to zero and the aircraft will fly the mission with their endurance reduced.

10.0 COMBAT PHASE
During the Combat Phase, both players should be at the computer viewing the action. The USAAF player should turn away when the Luftwaffe player is using the Situation Room routines. Only the Luftwaffe player is allowed to make keyboard inputs during the Combat Phase.

Certain equations in this section are printed in a lighter color; beginners need not read these to play the game. Intermediate and Advanced players, however, should find that the formulas contribute to a better understanding of how the computer determines values and percentages.

10.1 Game Clock
Each day the clock will start at 520 AM and run continuously until all raids have been completed. Game time is divided into 10-minute pulses. Each pulse all raids, patrols and intercept missions will move, search and possibly engage in combat. The Luftwaffe player may stop the clock's progress by using the Raids display routine or entering the Situation Room.

10.2 Raids Display
At any time during the Combat Phase the Luftwaffe Player may examine the detected USAAF raids by pressing the (R) key. The ID letters for detected raids will be listed. To examine a raid, press the key that corresponds to the raid ID. The cursor will move to the raid's location on the map and the raid's estimated size and altitude will be displayed.

10.3 Changing the Map
The U.S.A.A.F. Game Map covers a 48 × 24 square grid. Only a 20 × 10 area can be viewed at any one time. During the Combat Phase, the Luftwaffe player may alter the portion of the map being displayed by pressing keys 1-9. The map is divided into 9 areas that are situated as follows:

1 2 3
4 5 6
7 8 9

Thus by pressing the (1) key, the display will change to show the northwest portion of the map; by pressing the (9) key, the southeast portion of the map will be shown, etc.

10.4 USAAF Raid Resolution
(1) FORMING UP; the time required to form up is equal to assigned altitude divided by the climb rate. Raids that spend an entire pulse climbing will not move during the pulse. Raids that spend only part of the pulse climbing will receive partial movement.

(2) MOVEMENT; raids will move in a straight line towards an objective. A movement objective may be either a target or an offset point. Deep escorts will move towards the raid they are designated to escort.

(3) FUEL CONSUMPTION; groups spend 1 fuel point each turn they are in the air. Fighter groups spend 4 fuel points each time they participate in air-to-air combat. Fighter groups that exceed their operational fuel limit will turn back. Groups that turn back will be removed from the map. Groups will never be forced to ditch for lack of fuel.

(4) FLAK; raids may be subjected to flak attacks each pulse they spend in a city square. Airfield flak will only fire at raids that are attacking the airfield from less than 6000 feet. Raids flying in the TARGET square will be subjected to full strength flak. Raids flying through a non-target square will be attacked by ⅓ strength flak. Flak is primarily useful in disrupting bomber formations before they drop their bombs.

(5) LOCATING THE TARGET; bombers that enter a target square will attempt to visually sight the target. If the visual sighting fails due to cloud cover then the raid will proceed towards the secondary target. If the visual sighting fails and no secondary target has been assigned then the bombers will attempt to bomb using radar. Radar bombing will be only 10% as effective as visual bombing. The probability that a raid will fail to 'sight' the target is equal to the cloud cover percentage in the target's weather zone.

(6) OFFSET POINTS; raids will fly through their assigned offset points before proceeding directly to the target. Raids will fly through the offset point when returning to base unless the following exceptions apply: (a) the raid is shuttling to a different base, (b) the raid bombed a secondary target. Offset points may be useful in flying around heavy flak and fighter concentrations or in concealing the intended target until the last moment.

(7) RETURN TO BASE; after dropping their bombs or passing through their target points, the raids will set their return course. Shuttle raids will return to their new base. Other raids will return to their origin base. Returning raids will be removed from the map when they reenter the Allied fighter cover zone (see 11.13). Bomber raids will have their speed increased by 25 mph after dropping their bombs.

(8) RAID DETECTION; The Luftwaffe player will always receive advance notice of impending raids. A 'RAID FORMING UP' message will be displayed immediately after a raid takes off from its base. The 'RAID FORMING UP' message will be displayed each 10-minute pulse until the raid is detected. When a raid is detected, the cursor will move to the raid's current location, and the raid's estimated size and altitude will be displayed.

Raids that are still within the Allied Fighter Cover Zone will have a random chance of detection (the higher the

assigned altitude, the greater the chance of detection). Raids that fly beyond the Fighter Cover Zone will be automatically detected.

10.5 Luftwaffe Fighter Mission Resolution

(1) TAKING OFF; gruppes that have been assigned to fly intercept or patrol missions must first spend 1 pulse 'on the runway' preparing to take off. If the airfield is bombed while the fighters are on the runway then they will abort their mission.

(2) CLIMBING; following take off the fighters will climb to their assigned altitudes. Intercept missions will climb to the same altitude as the raid they are attempting to intercept. Fighter missions will suffer the same movement penalties for climbing as those described for USAAF raids.

(3) MOVEMENT; patrol missions will move in a straight line towards their assigned patrol area where they will remain until: (a) a different patrol area is assigned, (b) the patrol is assigned to intercept a USAAF raid, (c) the patrol sights a raid which it will automatically intercept, (d) the patrol runs low on fuel and returns to its assigned airfield. Intercept missions will move toward the raid they are attempting to intercept.

(4) FUEL CONSUMPTION; fighter missions will spend 1 fuel point each pulse they are in the air. Fighters use 2 fuel points each time they INITIATE air-to-air combat. Fighters (but not jets and rockets) use 4 fuel points when DEFENDING in air-to-air combat. Fighters use 10 fuel points to initiate a rocket attack. Fighter gruppes that exceed their operational fuel limit will turn back.

(5) LANDING & REFUELING; gruppes that turn back will be removed from the map display and will spend a variable period of time in 'landing mode'. The number of pulses required to land the gruppe is equal to the distance in squares from the turn-back point to the assigned airfield. Following the landing interval, the gruppe will spend an additional 3 pulses refueling. When refueling is completed, the gruppe will be ready for reassignment to intercept or patrol missions.

10.6 Air-to-Air Combat

Air-to-air combat is a two step procedure: combat initiation and combat resolution.

(1) REQUIREMENTS; only fighters may attempt to initiate air-to-air combat. Air-to-air combat may only occur between groups that occupy the same square on the map. Luftwaffe fighters may only initiate combat against raids they have been assigned to intercept. All air-to-air combat situations are resolved as a single attacking group vs. a single defending group. If more than one fighter group exists in the attacker raid/mission then each group will be given a separate chance to initiate combat. If more than one group is present in the defending raid/mission then the defending group will be determined randomly.

(2) FAILURE TO INITIATE COMBAT; if the requirements for air-to-air combat exist the fighters may still fail to initiate combat due to poor visibility, altitude difference or improper positioning.

(a) visibility—the probability of failure due to poor visibility is equal to the percentage of cloud cover in the weather zone.

(b) altitude—the probabilities of failure due to altitude difference are listed below:

3000 ft or less	0%
5000 ft	33%
7000 ft	67%
9000 ft or more	100%

(c) position—the probability of failure due to improper position varies with the fighter tactics:

DIRECT	0%
BOUNCE	70%
ROCKET	80%
all USAAF fighters	70%

(3) FIGHTER VS FIGHTER COMBAT RESOLUTION; combat is resolved by comparing the 'effectiveness' and size of the attacking group with the 'effectiveness' and size of the defending group. Fighter effectiveness is calculated as follows:

effectiveness = manueverability# × (400 − disruption)/400 × (experience + 100)/200 × (morale + 100)/200

The effectiveness of the attacking group is increased by 50% if it is a USAAF group attacking from an altitude advantage or a Luftwaffe gruppe using 'bounce' tactics. The following formula is used to determine the number of POSSIBLE KILLS suffered by the defender:

possible kills = 1 + attacker effectiveness / (1 + defender effectiveness) × number of attacking aircraft × random number / 8

After the defender losses have been deducted the number of POSSIBLE KILLS suffered by the attacker is determined:

possible kills = defender effectiveness / (1 + attacker effectiveness) × number of surviving defender aircraft × random number / 8

(4) FIGHTER VS BOMBER COMBAT RESOLUTION; fighter effectiveness is calculated as follows:

effectiveness = (70 + cannon# × 3) × (400 − disruption)/400 × (experience + 100)/200 × (morale + 100)/200

The effectiveness of the fighters is increased by 50% when using 'bounce' tactics.

Bomber effectiveness is calculated as follows:

effectiveness = 50 × (400 − disruption) / 400

The formula used to calculate the number of POSSIBLE KILLS suffered by the bomber group:

possible kills = 1 + fighter effectiveness / (1 + bomber effectiveness) × number of fighters × random number / 8

The number of POSSIBLE KILLS caused by bomber defensive fire is calculated BEFORE the bomber losses are subtracted. The formula for the number of POSSIBLE KILLS caused by bomber defensive fire is as follows:

possible kills = bomber effectiveness / (1 + fighter effectiveness) × defensive fire rating# × number of bombers × random number / 24

(5) ROCKET ATTACK RESOLUTION; rocket attacks may only be initiated by gruppes that have been assigned BOMBER ATTACK - ROCKET tactics. The rocket effectiveness is calculated as follows:

effectiveness = rocket rating# × number of fighters × experience / 100

Effectiveness of rocket attacks is doubled after 30 June 1944.

The number of POSSIBLE KILLS caused by rocket attacks is calculated:

possible kills = effectiveness × (200 − bomber disruption) / 200 × random number / 100

The amount of disruption caused by rocket attacks is calculated:

disruption = effectiveness × (200 − bomber disruption) / 200

The disruption caused by the rocket attack will be added to the bomber group's current disruption. Disruption can never exceed 99%.

NOTE: Rocket attacks will have LESS effect against bomber groups that have been previously disrupted. Rocket attacks worked best against tight formations of bombers.

After executing the rocket attack the fighters will immediately attack the same bomber group. This attack is resolved using the FIGHTER VS BOMBER COMBAT proceedure described above.

10.7 Flak Resolution

City flak will fire at USAAF raids whenever they begin their move in the city square. Airfield flak will only fire at raids that are attacking that airfield. Airfields will always be protected by 50 batteries of light flak. Cities may be protected by a maximum of 200 heavy and 200 light flak batteries.

When firing at USAAF raids, flak will attack each group within the raid with the entire effective flak strength. Flak effectiveness is calculated:

effectiveness = heavy flak × (30 − altitude) / 20 + light flak × (6 − altitude)

- see 12.0 for aircraft data

Flak effectiveness is divided by three when firing at a raid that is not in its target square.

Flak effectiveness is divided by three when firing at USAAF fighters.

The POSSIBLE KILLS resulting from flak are calculated:

possible kills = effectiveness × random number / 200 × (200 − disruption) / 200

The disruption resulting from flak is calculated:

disruption = effectiveness × random number × (200 − disruption) / 200

NOTE: Flak will be LESS effective when fired at groups that have been previously disrupted.

10.8 Possible Kills

During air-to-air combat or flak resolution, messages will be displayed indicating that aircraft have been destroyed or damaged. Each of these messages represents a POSSIBLE KILL. In determining how many possible kills have occurred, a random number between 0 and 1 will be added to the 'possible kill' number calculated in 10.6 or 10.7. Thus if the possible kill number was calculated as 1.45 then this would be adjusted to TWO 45% of the time and ONE 55% of the time.

Each time a possible kill is reported, the computer will randomly select one of three possible outcomes: false report, aircraft damaged, aircraft destroyed. Listed below are the probabilities of each occurrence:

33% false report
33% aircraft destroyed
34% aircraft damaged or destroyed (compare attacker firepower with defender durability)

In the last occurrence, the damaged/destroyed determination is calculated:

DAMAGED if: durability × random number > attacker firepower × random number

DESTROYED if: durability × random number <= attacker firepower × random number

In FLAK or ROCKET attacks, the firepower will always be 30. For bomber defensive fire the firepower will always be 2. In all other instances the firepower will be equal to the fighter's CANNON rating.

10.9 Bombing Results

When a USAAF raid bombs a target, the computer will calculate separately the damage percentage caused by each bomber group. The effectiveness of a bomber group is calculated:

effectiveness = (2 × experience + morale) / 3 × (125 − disruption) / 125 × (36 − altitude) / 36 × (200 − cloud cover) / 200

Effectiveness will be doubled if the disruption is less than 6%.

The damage caused by each bomber group is calculated:

damage = effectiveness × number of bombers × bomb load × random number / (target defense × 50)

The 'bomb load' is calculated by comparing the bomb rating for that type of aircraft to the distance in squares flown to the target:

bomb load = bomb rating# × (50 − distance) / 50

Fighters that are attacking ground targets add their cannon# to their bomb load.

Each type of target is rated separately for its defense (durability):

railyard (Overlord)	6
ball bearings	12
chemicals	7
oil	9
aviation gas	9
electric power	30
steel	12
rubber	10
U-boat	13
armaments	12
aircraft	10
V-weapon	10
submarine pens	20
airfields	20
flak	20
Nordhausen	50

Submarine pens are the U-boat targets located in Brest, St. Nazaire and Bordeaux. Nordhausen was a large underground factory complex. All target types located in Nordhausen will have a defense strength of 50.

Target defense strengths for targets with small industrial levels will be reduced as follows:

INDUSTRIAL LEVEL	DEFENSE ADJUSTMENT
1 - 4	× ⅓
5 - 9	× ½
10+	× 1

When attacking from altitudes greater than 25000 feet there is a chance that some or all of the attacking bomber groups will completely miss the target.

chance of missing target = (altitude − 25) × (100 − experience) / 500

Each attacking bomber group will roll separately to see if it misses the target.

When an airfield is damaged, aircraft and fuel on the base will also be damaged. For each 1% of damage to the airfield, 1% of the fuel will be destroyed, ½% of the aircraft caught on the ground will be damaged, and ½% of the aircraft will be destroyed. Fighter attacks on airfields will cause four times the amount of damage to aircraft as to the airfield itself.

10.10 Switzerland

Planes flying over Switzerland will be attacked by Swiss forces.

11.0 MISCELLANEOUS

11.1 Calculating Effective Industry Levels

The industry levels of each city are combined to find the total industry level for each type of industry. The total industry level may be reduced if that industry is 'dependent' on other 'critical' industries that have been extensively damaged.

An industry is considered to be 'extensively damaged' if it is reduced below its 'critical level'. Listed below are the critical industries and the industries that are dependent on them:

CRITICAL IND.	DEPENDENT INDUSTRIES
Railyard	U-boat, Armaments, Aircraft
Ball Bearings	Armaments, Aircraft
Chemicals	Oil, AvGas, Rubber, Armaments
Electric Power	All Other Industries
Steel	U-boat, Armaments
Rubber	Armaments

At the start of the game, all critical industries have a critical level of 50 except for railyards which have a critical level of 100. If a critical industry is reduced below its critical level then the following formula is used to find the effective industry level of the dependent industry:

effective industry level = dependent industry points × (100 − (critical level − critical industry strength)) / 100

EXAMPLE: the industry level for chemicals is reduced to 10, the critical level for chemicals is 50 and the industry level for oil is 100. The 'effective industry level' for oil will be 60 (= 100 × (100 − (50 − 10)) / 100)

EXCEPTION: extensively damaged railyards will affect the aircraft industry in a different manner than that described above. Individual aircraft cities will be reduced in the following manner if railyards are reduced below 80:

REDUCTION	AIRCRAFT INDUSTRY SIZE
10%	greater than 9
75%	less than 10

At the end of each turn that a critical industry is below its critical level there is a random chance that the critical level will be REDUCED by 10. The chance of reduction is equal to HANDICAP LEVEL / 500. The players will not be informed when the critical level has been reduced.

11.2 Calculating Axis Industrial Damage Level

The Axis Industrial Damage Level (AIDL) is used to measure the USAAF player's success in hindering the Axis war effort. Damage points are added to the AIDL when various industries are reduced to various levels. The matrix displayed in the chart to the right reflects the points scored for reducing each industry.

The AIDL (DAMAGE) will be displayed at the top of the Intelligence Briefing menus.

11.3 Aircraft Replacements

Replacement aircraft will be added at the end of each day. USAAF replacements will arrive on a fixed schedule. Luftwaffe replacements will vary with Luftwaffe players production decisions and the effective aircraft industry levels.

USAAF REPLACEMENT SCHEDULE

AIRCRAFT TYPE	AIRCRAFT PER DAY	AIRCRAFT PER DAY	AIRCRAFT PER DAY
P40E	8/43 = 9	1/44 = 1	
P47B	8/43 = 3	9/43 = 1	
P47D	8/43 = 0	9/43 = 12	1/44 = 18
P51B	8/43 = 0	11/43 = 3	4/44 = 1
P51D	8/43 = 0	3/44 = 18	
P38G	8/43 = 9	12/43 = 1	
P38J	8/43 = 0	12/43 = 12	
B17F	8/43 = 1		
B17G	8/43 = 18		
B24D	8/43 = 3	10/43 = 1	
B24J	8/43 = 0	10/43 = 12	1/44 = 18

LUFTWAFFE AIRCRAFT PRODUCTION RATES

	AIRCRAFT PRODUCED PER 100 FACTORIES	LATEST POSSIBLE AVAILABILITY DATE
ME109G	15	8/43
ME109K	12	8/44
FW190A	10	8/43
FW190D	9	6/44
FW190F	8	8/43
TA152H	8	1/45
DO335A	7	3/45
ME410A	7	8/43
ME110G	8	8/43
JU88G	0*	8/43
ME262A	4	11/44
ME163B	6	9/44
HE162A	10	3/45

* Only a fraction of the production of this type of aircraft was available for daylight air defense of the Reich, so the German player will automatically receive one JU88G per day.

The daily replacements for each type of aircraft are calculated by comparing the production rate with the aircraft industry level for that type of aircraft:

replacements = production rate × industry level / 100

Daily replacements will be added to the replacement pool. The replacement pool may contain a maximum of 255 aircraft of any one type. The adjusted industrial level of an aircraft type can never exceed 255.

Each turn replacement aircraft may be distributed to depleted groups. A maximum of 3 aircraft per day will be added to groups that receive replacements. All replacement activity is controlled by the computer.

11.4 Luftwaffe Aircraft Availability

Certain Luftwaffe aircraft types are not available at the start of the game (8/43). Availability dates are listed on the LUFTWAFFE AIRCRAFT PRODUCTION RATE chart.

Each month there is a random chance that the availability date for each aircraft type will be accelerated by 1 month.

availability acceleretion chance = handicap level × aircraft factories / 1000

EXAMPLE: In hope of receiving ME262A jets sooner than 11/44 the Luftwaffe player has converted 100 aircraft factories to ME262A production. At handicap level 3 there will be a 30% chance each month that ME262A availability will be accelerated.

The players will not be informed that the availability date has been accelerated.

At the start of the Phase III scenarios, the ME262A is available.

11.5 USAAF Allowable Targets

The USAAF player may be limited in the targets he is allowed to bomb. At the start of the game chemicals, electric power and steel industries may not be attacked. Each turn there will be a 1/1000 chance that one of these industry types will become an allowable target. These industries will automatically become allowable on the following dates:

chemicals	6/44
steel	9/44
electric power	1/45

11.6 USAAF Political Targets

At various times during the Campaign Games the USAAF player will be restricted to bombing specific targets for political reasons. U-boats, V-weapons and Overlord (railyards in France, Belgium and Italy) may be selected as political targets at various points in the game.

Only the USAAF bombers based in England (8th Air Force) will be affected by the political target restrictions. When a political target has been declared, no other target types except airfields and flak may be targeted by the 8th Air Force. The political target will remain in effect until the USAAF has inflicted satisfactory damage to the political target industry or the Allied High Command loses interest in that industry.

In 1943 and 1945, U-boats may become political targets. In 1943, unchecked growth of the sub-pens in France will trigger a 'political reaction'. A significant reduction in the sub-pens or the submarine factories will satisify the High Command. In 1945, the advanced U-boat designs may take their toll of Allied shipping and trigger a political reaction. At this stage of the war a 'token' raid against a U-boat factory will satisfy the High Command.

From April through August 1944, V-weapons may become political targets. Unchecked growth of 'launch sites' in Cherbourg, Calais and LeHavre may trigger a political reaction. A significant reduction in the launch sites or the V-weapons factories will satisfy the High Command.

During May through August 1944, the USAAF must assist in preparation for the invasion of France. During this period, the USAAF must reduce the Overlord railyards to less than 15 total points.

11.7 Flak Production

Flak reinforcements are produced in cities with armaments factories. Each day there is a chance that new flak batteries will be added to armaments cities. The formula for adding flak is as follows:

new flak = armaments industry level + 100 × random number / 100 (fractions rounded down)

EXAMPLE: if the city armaments level is 60 there is a 60% chance that 1 heavy flak battery will be added and a 40% chance that no heavy flak will be added. The procedure would be repeated to determine light flak reinforcements.

EXAMPLE: if the city armaments level is 140 there is a 40% chance that 2 heavy flak batteries will be added and a 60% chance that only 1 heavy flak battery will be added, etc.

For the purpose of determining flak reinforcements, the armaments industry level is NOT affected by damage to critical industries.

11.8 Airfield Fuel Replenishment

Each day the effective industry total for aviation gas will be added to the National Aviation Fuel Reserve (NAFR; this number will not exceed 200). Also, each day a number of fuel points equal to the handicap level will be added to the NAFR. If the NAFR total is greater than 99 then airfield fuel replenishment will occur.

Fuel replenishment will only affect

INDUSTRY	0-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90+
railyard	20	15	10	5	4	3	2	1	0
ball bearings	5	4	3	2	1	0	0	0	0
chemicals	5	4	3	2	1	0	0	0	0
oil	20	15	10	5	4	3	2	1	0
aviation gas	5	4	3	2	1	0	0	0	0
electric power	20	15	10	5	4	3	2	1	0
steel	5	4	3	2	1	0	0	0	0
rubber	5	4	3	2	1	0	0	0	0
U-boat	5	4	3	2	1	1	1	0	0
armaments*	30	25	20	15	10	5	3	1	0

* Divide armaments level by 10 before comparing to the damage matrix.

active airfields that contain at least 1 fighter gruppe and with damage less than 50%.

Airfields with less than 101 fuel will add 100 fuel points and 2 points will be subtracted from the NAFR.

Airfields with less than 151 fuel will add 50 fuel points and 1 point will be subtracted from the NAFR.

11.9 Reinforcement Groups

Reinforcement groups will become available during the game in accordance with the Reinforcement Schedule (see 13.0).

New reinforcement groups will only be received if there are adequate numbers in the aircraft replacement pool to 'buy' the new group. Certain Luftwaffe gruppes represent transfers from other fronts. Transferred reinforcement gruppes are not 'bought' from the replacement pool.

11.10 Experience

Fighter groups add 1 experience point each time they participate in air-to-air combat. Groups add 1 or 2 experience points each time they bomb a target. Groups with experience less than 50 will automatically gain 1 experience per turn. However, if the German fuel reserve is less than 100, their gruppes will not receive this automatic experience gain. Groups with experience less than 71 gain experience for just flying:

CURRENT EXPERIENCE	EXPERIENCE GAINED
51-70	1
31-50	2
0-30	3

Groups with experience greater than 90 lose experience for just flying:

CURRENT EXPERIENCE	EXPERIENCE LOST
91-110	1
111-130	2
131+	3

Groups will lose experience when replacements are added. USAAF replacement crews will have experience equal to 2/3 of the experience rating of the group they are joining. Luftwaffe replacements will have experience equal to zero.

The computer will keep track of how many pilots are available in Luftwaffe fighter gruppes. When German aircraft are destroyed in combat, there is a 50% chance that the pilot will be lost. When German aircraft are destroyed during take-offs or landings the pilot will always be lost. Replacement pilots will be added (and experience will be reduced) only when there are more serviceable aircraft than there are pilots in a gruppe.

11.11 Morale

At the end of each day groups with morale ratings less than their experience ratings will add 2 morale points for USAAF groups and 4 morale points for Luftwaffe groups. Groups lose 5% of their morale each time they fly. Groups lose 5% of their morale for each aircraft destroyed in combat. Luftwaffe gruppes that are bombed on the ground will lose 1 morale point for each point of damage the airfield sustains.

11.12 Building Industry

At the end of each day there is a chance that cities will increase their industry strength. The table below shows the chance for building industry strength and the optimum level for each type of industry:

TYPE	BUILD	OPTIMUM
railyard (Overlord)	8%	2
ball bearings	5%	5
chemicals	5%	6
oil	7%	5
aviation gas	7%	10
electric power	1%	3
steel	2%	8
rubber	5%	10
U-boat	3%	8
armaments	*4%	50
aircraft	*4%	50
V-weapon	4%	10

* The build chance for armaments will increase to 12%, and the build chance for aircraft will increase to 20% starting 1/44.

If the industry strength for a city is equal to ZERO then the build chance will be divided by 5. If the industry strength for a city is greater than or equal to the optimum level then the build chance will be divided by 5. If the industry strength is greater than 3 × optimum level then the industry strength may not be increased.

The build chance for all industries will be reduced by 1% for each point that STEEL is reduced below 25. Thus if steel is reduced to 10 points then new industries will build only 85% as fast as normal, etc.

A city will only build types of industry that are in that city at the start of the game. Thus Nordhausen which starts the game with only aircraft and V-weapon industries will only build aircraft and V-weapon industry during the game.

EXCEPTION: At the start of the game there are certain cities with industrial sites for ball bearings, aircraft and V-weapons under construction. These industries may build during the game even though they started with a strength of zero.

11.13 Allied Fighter Cover Zones

Certain areas of the map will be designated as Allied Fighter Cover Zones (see player aid map). Luftwaffe aircraft may not enter a fighter cover zone and USAAF raids will be more difficult to detect while flying through these zones.

At the start of the game (8/43), the fighter cover zone will be limited to the area in and around England. During the game, fighter cover zones will expand to cover the following areas:

SOUTHERN ITALY	10/43
NORMANDY	6/44
CENTRAL ITALY, FRANCE, BELGIUM	9/44

11.14 Advancing Allies

During the campaign games certain areas that start the game in German control will be captured by the advancing Allied Armies. These areas will include the Allied Fighter Cover Zone areas described in 11.13. In addition the Soviet Armies will overrun EASTERN EUROPE in 9/44 (the area east of Warsaw, not inclusive).

In areas captured by the Allies, all German industry, flak and active airfields will be destroyed. Fighter Gruppes based on captured airfields will be removed from the game and returned as reinforcements within 2 months.

11.15 Jet and Rocket Aircraft

The following special rules apply to Luftwaffe jet (ME262A, HE162A) and rocket (ME163B) aircraft:

(A) Fuel Consumption; jets and rockets do NOT require or consume fuel points when flying combat missions. These aircraft did not use the specially refined aviation gas that the piston engined fighters used. Jets and rockets do not expend fuel when defending against USAAF fighter groups.

(B) Air to Air Combat; when jets and rockets engage in air to air combat they will suffer 1/20 of the 'possible kills' calculated in 10.6. This applies when encountering USAAF fighters or bomber defensive fire.

12.0 AIRCRAFT DATA

ID#	TYPE	CN	MV	DU	RR	SP	FU	MA	CL	C
1	ME109G	8	38	17	2	42	7	38	30	1
2	ME109K	7	50	17	2	46	6	41	41	1
3	FW190A	10	44	18	2	44	8	37	18	1
4	FW190D	6	48	19	2	46	8	39	28	1
5	FW190F	15	32	25	6	42	8	35	12	1
6	TA152H	13	48	24	2	50	10	49	48	1
7	DO335A	19	45	19	2	50	13	37	30	3
8	ME410A	13	22	20	6	40	17	33	18	2
9	ME110G	18	18	19	4	36	13	26	12	2
10	JU88G	12	18	23	4	36	21	32	12	2
11	ME262A	20	14	14	6	68	5	38	28	7
12	ME163B	10	40	10	0	96	2	40	40	8
13	HE162A	10	21	7	2	52	4	39	39	6

ID#	TYPE	CN	MV	DU	BL	SP	FU	MA	CL	C
14	P40E	6	37	14	1	40	10	30	18	1
15	P47B	8	44	22	2	40	10	42	18	1
16	P47D	8	46	23	3	40	12	40	24	1
17	P51B	4	46	18	2	42	16	42	24	1
18	P51D	6	48	18	2	42	23	42	24	1
19	P38G	6	36*	19	2	36	19	39	20	2
20	P38J	6	44*	23	3	40	25	44	26	2
21	B17F	9	0	42	9	28	90	33	8	4
22	B17G	10	0	43	16	28	90	31	12	4
23	B24D	9	0	32	9	30	90	25	6	4
24	B24J	9	0	33	13	30	90	24	8	4

* At altitudes greater than or equal to 20000 feet, the maneuverability ratings of the P38G and P38J are reduced to 27 and 33, respectively.

CN cannon rating; this is the defensive fire rating for heavy bombers
MV maneuverability rating
DU durability rating
RR rocket rating
BL bomb load rating
SP speed ratings: miles per 10-minute pulse
FU operational fuel limit: fuel used before turning back
MA maximum altitude
CL climb rate: thousands of feet per 10-minute pulse
C aircraft class

13.0 ORDER OF BATTLE

LUFTWAFFE

FW190A GRUPPES

1,2,3/JG1		
1,2,3/JG2		
1/JG11		
1,2,3/JG26		
3/JG54		
3/JG11	5/44	NEW
JGR200	7/44	
1,2,4/JG54	8/44	
JGR10	11/44	

FW190F GRUPPES

1,2,3,4/SKG10		
1,2,3/SG4	10/43	
1/SG2	4/44	
2/SG2	7/44	
2,3/SG1	9/44	
2,3/SG3	9/44	
1/SG5	10/44	
1,2,3/SG10	10/44	
1,2/SG77	10/44	
3/SG77	11/44	
1,2,3/KGJ6	11/44	NEW
1,2,3/KGJ27	11/44	
1,2,3/KGJ30	11/44	
1/SG1	12/44	

ME109G GRUPPES

1/JG4		
2/JG11		
1/JG25		
1,2,3,4/JG27		
2/JG51		
1,2,3/JG53		
1,2,3/JG77		
RJG1	RUMANIAN	
HJG101	HUNGARIAN	
BJG6	BULGARIAN	
IJG3	ITALIAN	
IJG150	ITALIAN	
1,2,3/JG3	8/43	
4/JG3	12/43	
1/JG5	1/44	
1/JG50	1/44	
1/JG76	5/44	
2/JG5	6/44	
3/JG76	6/44	
1,3,4/JG51	8/44	
1,2,3/JG52	8/44	
1,2,3,4/EJG1	11/44	

ME110G GRUPPES

2/ZG1		
3/ZG26		
1/ZG1	8/43	
1/ZG26	11/43	NEW
1/ZG76	4/44	
2/ZG76	5/44	

ME410A GRUPPES

3/ZG1		
2/KG51	10/43	
2/ZG26	11/43	NEW
1,3/KG51	2/44	

JU88G GRUPPES

1,2/NJG2	8/43	
3/NJG2	9/43	

ME262A GRUPPES

JV44	6/44*	NEW
1/JG7	6/44*	NEW
2/JG7	6/44*	NEW
3/JG7	6/44*	NEW
4/JG7	6/44*	NEW
1/EJG2	6/44*	NEW
2/EJG2	7/44*	NEW
3/EJG2	8/44*	NEW
1,2,3/KGJ54	9/44*	NEW
1,2,3/KGJ55	11/44	NEW
4/EKG1	12/44	NEW

* – arrival may be delayed pending availability of the ME262A

NEW – newly formed gruppe, must have sufficient aircraft in the replacement pool to buy the gruppe (all USAAF reinforcement groups are NEW)

USAAF

B17F GROUPS

ENGLAND
91,92,94,95,96,100,303,305,306,351,379,381,384,385,388,390BG

TUNISIA-ITALY
2,97,99,301BG

B17G GROUPS

ENGLAND	
482BG	8/43
401BG	11/43
447BG	12/43
452,457,493BG	1/44
4,398,486,487, 490BG	4/44
ITALY	
463BG	3/44
483BG	4/44

B24D GROUPS

ENGLAND	
392BG	8/43
LIBYA-ITALY	
44,93,98,376,389BG	

B24J GROUPS

ENGLAND	
445,446,448BG	11/43
453BG	12/43
491,492BG	1/44
458BG	2/44
466BG	3/44
467,489BG	4/44
ITALY	
449,450,451, 454,455,456BG	1/44
459,460,461BG	2/44
464,465,484, 485BG	4/44

P40E GROUPS

TUNISIA-ITALY	
33,57,79FG	9/43
324FG	10/43

P47B GROUPS

ENGLAND	
4,56,352,353, 355FG	
356FG	8/43

P47D GROUPS

ENGLAND	
358,359FG	10/43
361,362FG	11/43
365FG	12/43
366FG	1/44
368FG	2/44
48,371,405FG	3/44
50,373,404, 406FG	4/44
ITALY	
325FG	10/43
86FG	1/44
332FG	2/44

P38G GROUPS

ENGLAND

78FG	
20FG	8/43
55FG	9/43

TUNISIA-ITALY

1,14,81,82FG	
350FG	11/43

P38J GROUPS

ENGLAND

370FG	2/44
474FG	3/44
367FG	4/44

P51B GROUPS

ENGLAND

354FG	11/43
357FG	12/43
364FG	2/44

ITALY

31FG	11/43
52FG	2/44

P51D GROUPS

ENGLAND

339FG	4/44
479FG	5/44

14.0 VICTORY DETERMINATION

14.1 Calculating the Score

In all scenarios (both short and campaign) the USAAF player's base score will equal the AIDL (see 11.2).

In short scenarios the FINAL SCORE will be equal to the AIDL × loss ratio. In the campaign game the FINAL SCORE equals 12 + 4 × the number of months before May 1945 that the game ended (if the game ends after May 1945 this will be a negative number).

14.2 Loss Ratio

The loss ratio is calculated:

loss ratio = Luftwaffe fighter losses × 2 / (2 × USAAF bomber losses + USAAF fighter losses)

In Phase III games, divide the loss ratio by 2. In all games, if the number of bombers destroyed is less than 1000 and the loss ratio is less than 1.0 then the loss ratio will be increased to 1.0.

14.3 Victory Levels

The final score is compared to the following chart to determine the level of victory for each scenario:

	SHORT SCENARIOS			CAMPAIGN
	PHASE I	II	III	ALL
LUFTWAFFE DECISIVE	—	—	—	—
	0	20	50	0
LUFTWAFFE MARGINAL	1	21	51	1
	3	35	65	15
USAAF MARGINAL	4	36	66	16
	7	49	79	30
USAAF DECISIVE	8	50	80	31
	+	+	+	+

15.0 SCENARIOS

The players may select from three time periods or 'Phases' at the start of the game.

15.1 Phase I

Starts 1 August 1943. The USAAF has been in action against Germany for over a year but has only recently received bombers in sufficient quantities to fly 'deep penetration' raids. USAAF fighters consist of the short winded P47B and the awkward P38G.

In response to the growing USAAF threat, the Reich Air Defense has been heavily reinforced with gruppes from the Mediterranean and Eastern Fronts. Experienced German pilots flying ME109G and FW190A fighters are more than a match for their USAAF opponents. Heavily armed ME110G, ME410A and JU88G 'destroyer' aircraft have been introduced to deal exclusively with USAAF bomber formations.

When playing the Phase I SHORT game it is recommended that experienced players play the USAAF side. We also recommend that only experienced players play Phase I.

15.2 Phase II

Starts 1 February 1944. After some serious reverses in the second half of 1943 the USAAF has reinforced and reequipped its fighter groups. Flying large numbers of P47Ds and P38Js and a few precious groups of P51Bs the USAAF can at last provide escorts continuously to and from the target on deep penetration raids.

As the USAAF has gained experience and improved equipment, Luftwaffe quality has remained unchanged. The ME109G is still widely used despite being outclassed by new USAAF fighter types. Axis production has been reorganized and development of advanced fighter designs has begun.

15.3 Phase III

Starts 1 October 1944. After crippling the German fuel industries in the Summer of 44, the USAAF has victory within its grasp. As the Allied Armies bog down on the German border it is hoped that strategic bombing can hasten the collapse of the Axis war machine.

The Luftwaffe has been reduced to a shambles by the past 9 months of heavy fighting. Axis aircraft production has reached record heights but shortages of fuel and experienced pilots have made this irrelevant. Luftwaffe hopes rest on increased availability of advanced fighter types such as the FW190D, ME109K and ME262A.

All critical industries have their critical level set to 30. The ME-262A has already begun production at the start of Phase III. When playing the Phase III SHORT game, it is recommended that advanced players play the Luftwaffe side.

16.0 STRATEGY NOTES

USAAF Player

Short Games – In the short games you should pick one industry (preferably a critical industry) that can give you a lot of points quickly, and then destroy that one industry. Ball bearings and/or rubber are good targets, as is chemicals/steel/electric power if they are available as targets. In phase I and phase II games railyards can be a good target due to its high critical level. Do not waste your time bombing targets in many different industries, as this will not score points in the short run.

Aviation Gas – By reducing aviation gas to below 5 (and keeping it there) you will be able to ground the Luftwaffe. Bombing chemicals if available is a good way to help keep up an aviation gas shortage, so a good time to bomb aviation gas is just after chemicals is discovered as a target. Keep in mind that you may have to wait several weeks to begin seeing the effect, and that you will have to make many deep raids against 1 and 2 point targets to maintain the fuel shortage, but the results can be well worth the effort.

Escorts – Proper use of your escorting fighters can make or break your grand strategy. Remember to send out your fighters on deep escort from 30-50 minutes later than the bombers so that they don't waste fuel while waiting for the slow climbing bombers to form up, and send them out at 1-3000 feet above the bombers (by staggering the elevation of your escorts the high groups will be able to bounce German fighters that are attacking your low groups). Also, don't forget to send fighters out to cover the bombers on their return trip, otherwise the Luftwaffe will devastate your home-bound bombers. Let's assume you have the following fighters available to cover a raid on Berlin which will form up at 600 at 22000 feet: 10 × P47D, 8 × P51D, 3 × P38J. A matching escort schedule could look like this:

630 - 6 P47 23000 feet
640 - 3 P51 24000 feet
700 - 3 P38 25000 feet
710 - 2 P51 25000 feet
800 - 3 P51 23000 feet
920 - 4 P47 24000 feet

This plan provides escort cover all the way to Berlin and back. This is just a suggested allocation of escorts, and it is left to you to discover the "optimum" escort tactics.

Luftwaffe Player

Flak – You should attempt to concentrate flak in those cities you expect to be bombed. For example if you see that the American player is attempting to destroy your rubber plants, place 195 heavy batteries in each of the major rubber targets as soon as possible. Also, protect those industries that are especially important

to your defense (i.e. aviation gas, aircraft factories, chemicals). Never place 200 batteries in a city, for you will lose any batteries that the cities armament factories produce. Placing flak is purely a matter of anticipating the USAAF player's intentions.

Aircraft – Keep your single engine fighters based on airfields in France, Northwest Germany, and Italy and base your rocket firing bomber-destroyers in central and southern Germany. It is wise to concentrate a large number of airfields and air gruppes around Essen. Use your high manueverability fighters (greater than 35) to bounce enemy fighters, especially P-38 and P-51 long-range fighters. If you are successful at forcing these fighters to turn back, you can unleash your bomber-destroyers to attack deep raids into Germany. The ME410, ME110, and JU88 should be equipped with rockets and launched last, but be forewarned that if they are attacked by American fighters they will be decimated. Do not fly units with less than 20-25 serviceable planes, and pull units back to the safety of central German airfields if their morale is reduced below 40. Try to keep your best units poised on the front line airfields, but realize that you will lose morale each time you shuttle an air gruppe from one field to another.

Patrols – Patrols are useful in two ways. First they can be used to mass a large number of aircraft in one spot. This will allow you to launch a coordinated attack that may be able to overwhelm the escorts. Patrols can also be used to shield the French coast against USAAF fighter raids on German airfields.

Aircraft Production – This is your chance to build the Luftwaffe to suit your own style of warfare. It's usually a good idea early in the game to convert some or all of your ME109G factories to the production of FW190A fighters. Although this will result in lower production, you will generally find that you have all of the ME109G's you would ever want especially when you begin to convert whole gruppes to the new plane types. If you believe that the USAAF player is going to concentrate on destroying your aviation gas (and most do), it's a very good idea to convert some of your factories to ME262A production in order to speed up the arrival of your jets (remember that jets do not require aviation gas to fly). If the USAAF player does not bomb your aircraft factories, you will find that you have plenty of production capacity that can be spared on jet production. If however, the USAAF player concentrates on your aircraft factories, and he catches you converting all of your factories to new production, you may find yourself facing a critical shortage of aircraft.

CREDITS

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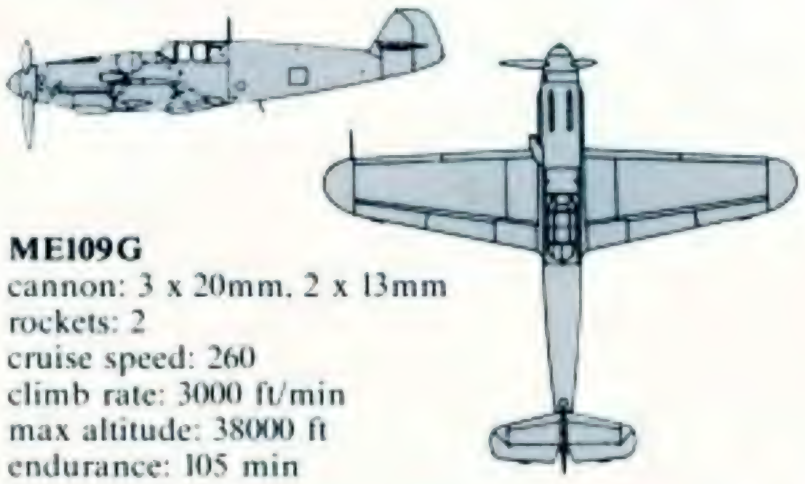
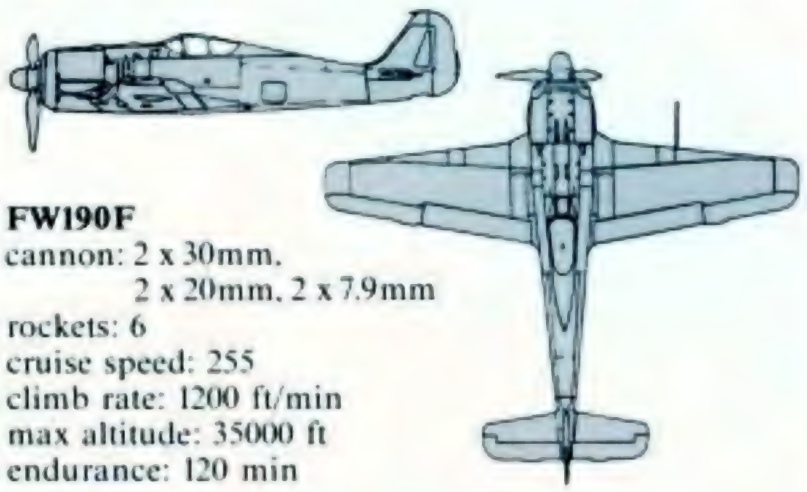
Or call our Hotline Number: *(415) 964-1200* every weekday, 9 to 5 (P.S.T.).

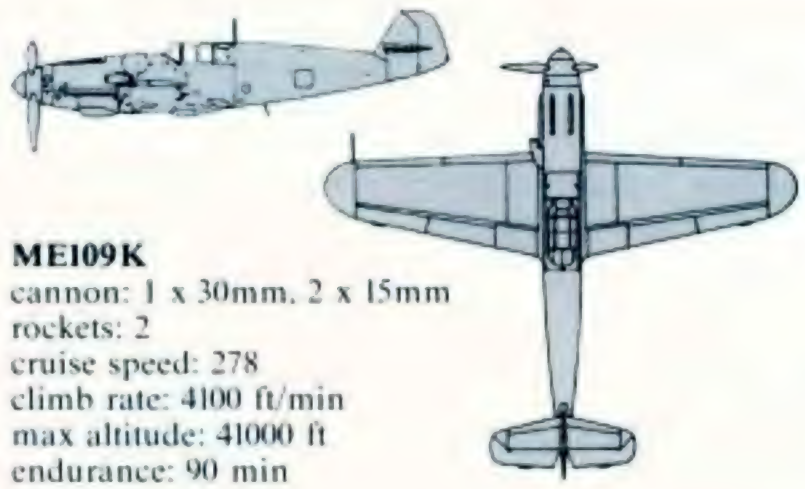
17.0 AIRCRAFT DIAGRAMS



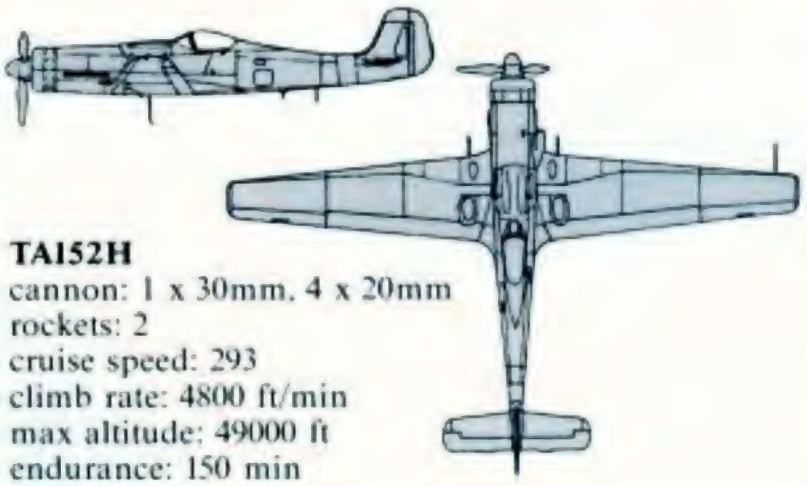
ME109G
cannon: 3 x 20mm, 2 x 13mm
rockets: 2
cruise speed: 260
climb rate: 3000 ft/min
max altitude: 38000 ft
endurance: 105 min



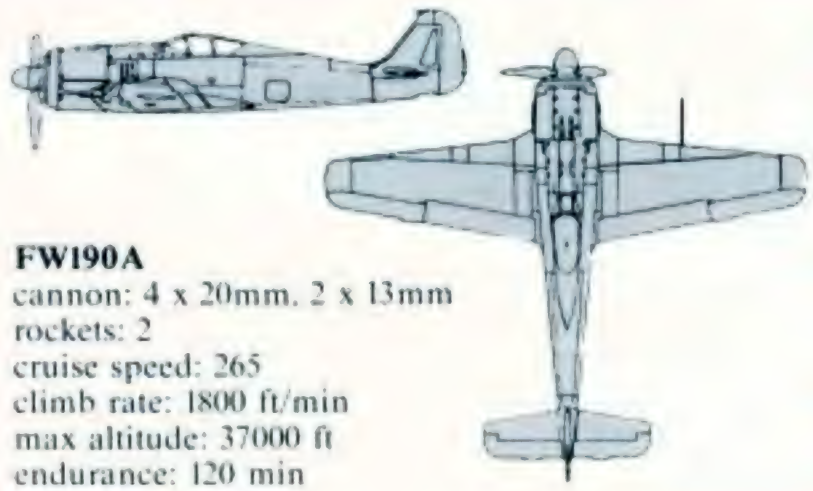
FW190F
cannon: 2 x 30mm,
2 x 20mm, 2 x 7.9mm
rockets: 6
cruise speed: 255
climb rate: 1200 ft/min
max altitude: 35000 ft
endurance: 120 min



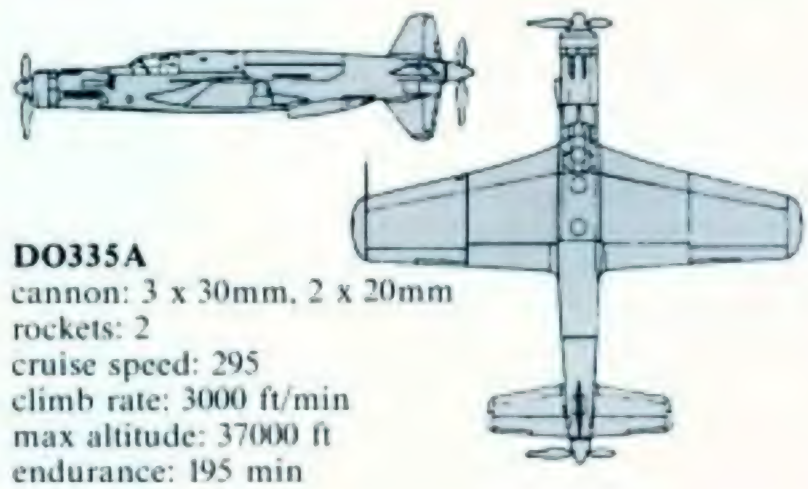
ME109K
cannon: 1 x 30mm, 2 x 15mm
rockets: 2
cruise speed: 278
climb rate: 4100 ft/min
max altitude: 41000 ft
endurance: 90 min



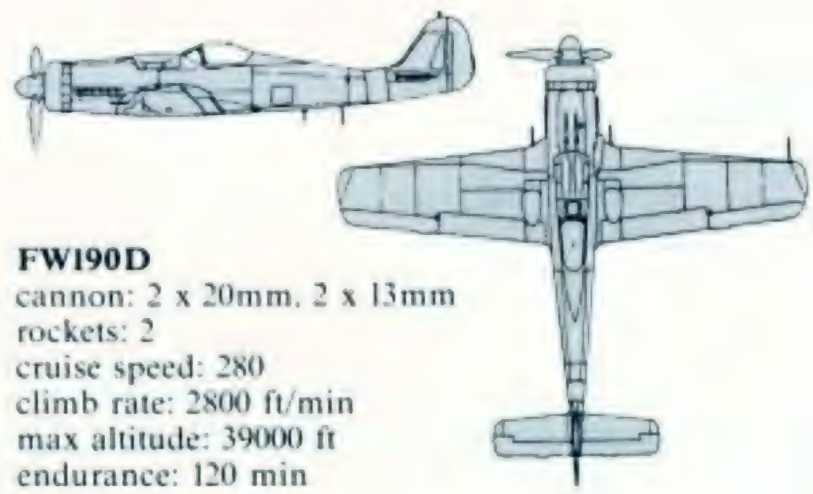
TA152H
cannon: 1 x 30mm, 4 x 20mm
rockets: 2
cruise speed: 293
climb rate: 4800 ft/min
max altitude: 49000 ft
endurance: 150 min



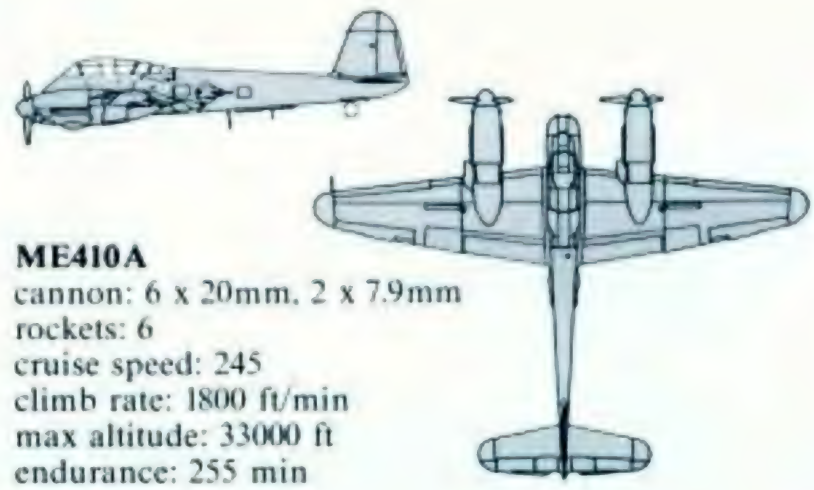
FW190A
cannon: 4 x 20mm, 2 x 13mm
rockets: 2
cruise speed: 265
climb rate: 1800 ft/min
max altitude: 37000 ft
endurance: 120 min



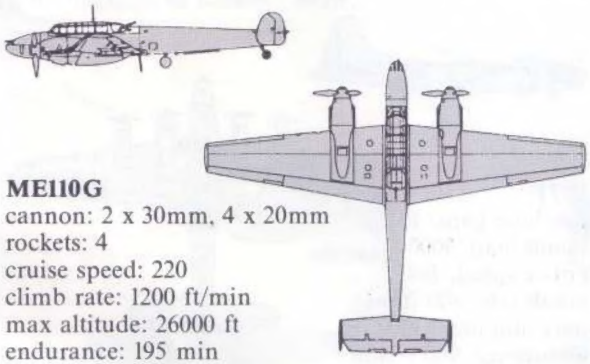
DO335A
cannon: 3 x 30mm, 2 x 20mm
rockets: 2
cruise speed: 295
climb rate: 3000 ft/min
max altitude: 37000 ft
endurance: 195 min



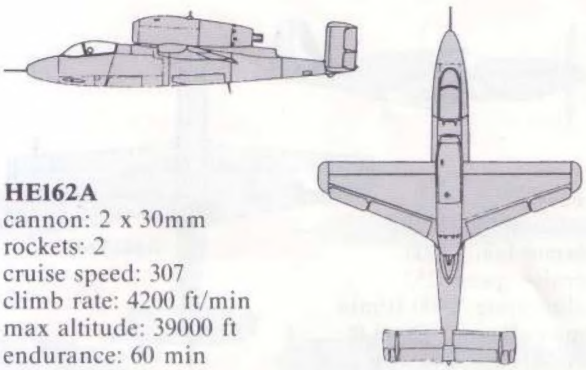
FW190D
cannon: 2 x 20mm, 2 x 13mm
rockets: 2
cruise speed: 280
climb rate: 2800 ft/min
max altitude: 39000 ft
endurance: 120 min



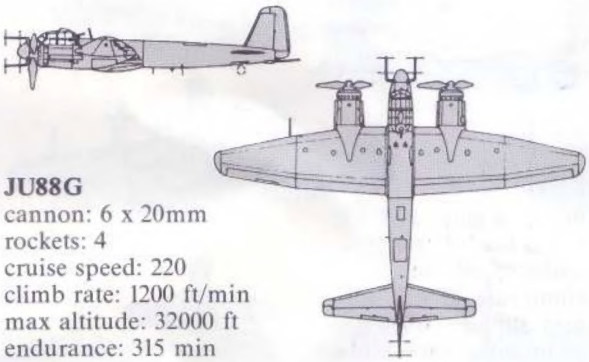
ME410A
cannon: 6 x 20mm, 2 x 7.9mm
rockets: 6
cruise speed: 245
climb rate: 1800 ft/min
max altitude: 33000 ft
endurance: 255 min



ME110G
cannon: 2 x 30mm, 4 x 20mm
rockets: 4
cruise speed: 220
climb rate: 1200 ft/min
max altitude: 26000 ft
endurance: 195 min

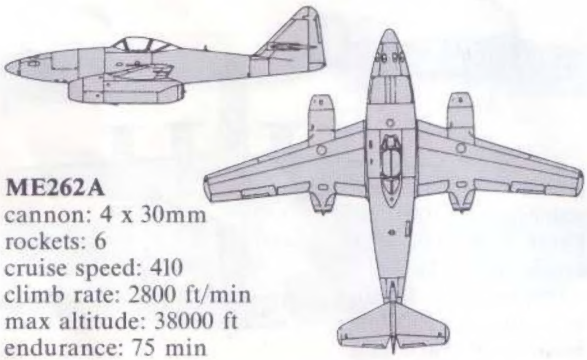


HE162A
cannon: 2 x 30mm
rockets: 2
cruise speed: 307
climb rate: 4200 ft/min
max altitude: 39000 ft
endurance: 60 min

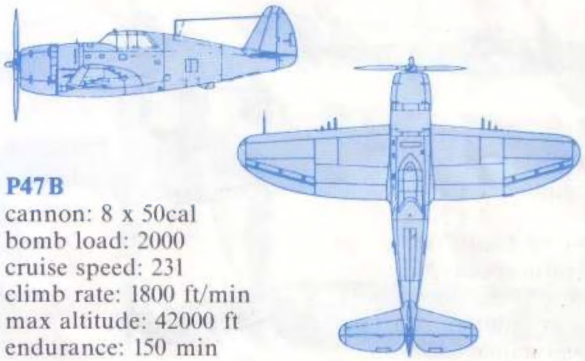


JU88G
cannon: 6 x 20mm
rockets: 4
cruise speed: 220
climb rate: 1200 ft/min
max altitude: 32000 ft
endurance: 315 min

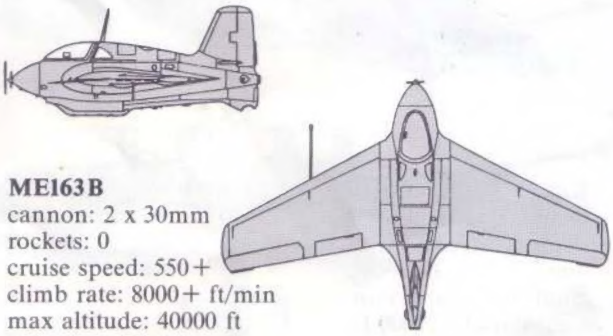
P40E
cannon: 6 x 50cal
bomb load: 1000
cruise speed: 245
climb rate: 1800 ft/min
max altitude: 30000 ft
endurance: 150 min



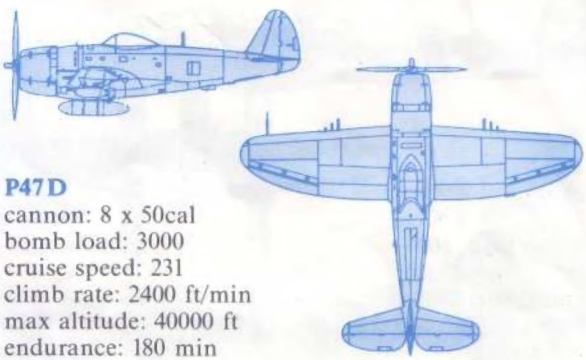
ME262A
cannon: 4 x 30mm
rockets: 6
cruise speed: 410
climb rate: 2800 ft/min
max altitude: 38000 ft
endurance: 75 min



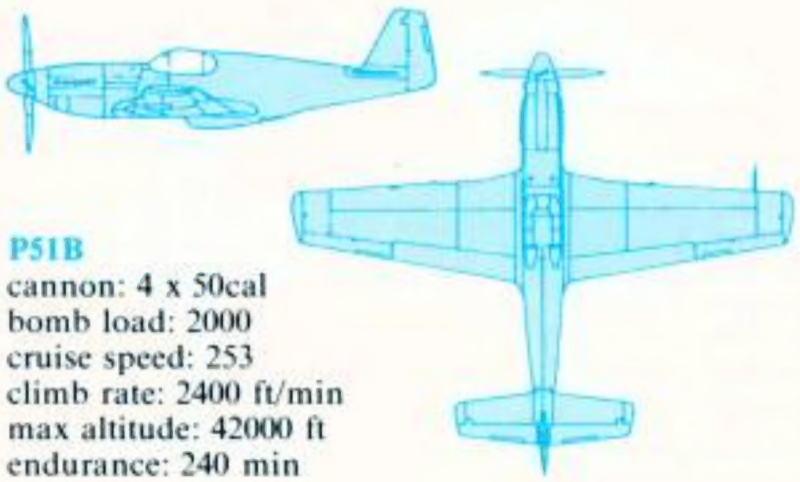
P47B
cannon: 8 x 50cal
bomb load: 2000
cruise speed: 231
climb rate: 1800 ft/min
max altitude: 42000 ft
endurance: 150 min



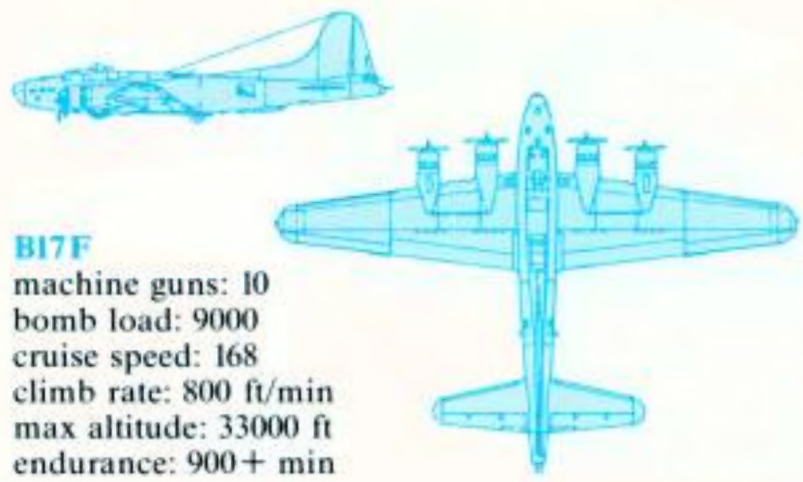
ME163B
cannon: 2 x 30mm
rockets: 0
cruise speed: 550+
climb rate: 8000+ ft/min
max altitude: 40000 ft
endurance: 8 min



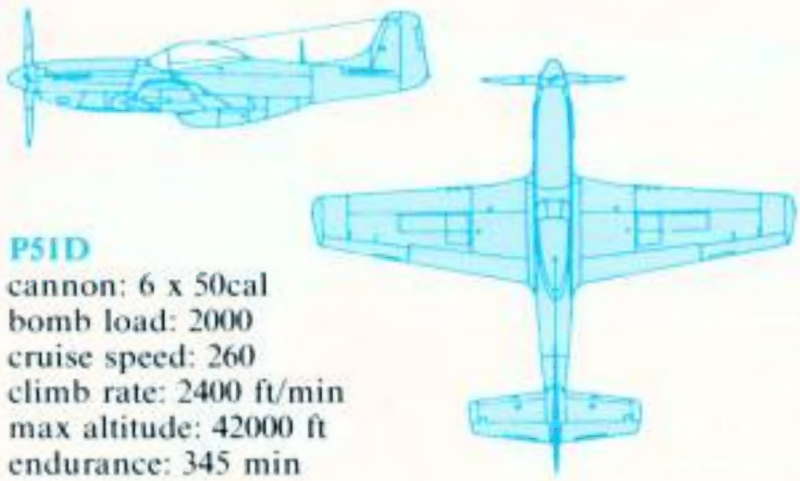
P47D
cannon: 8 x 50cal
bomb load: 3000
cruise speed: 231
climb rate: 2400 ft/min
max altitude: 40000 ft
endurance: 180 min



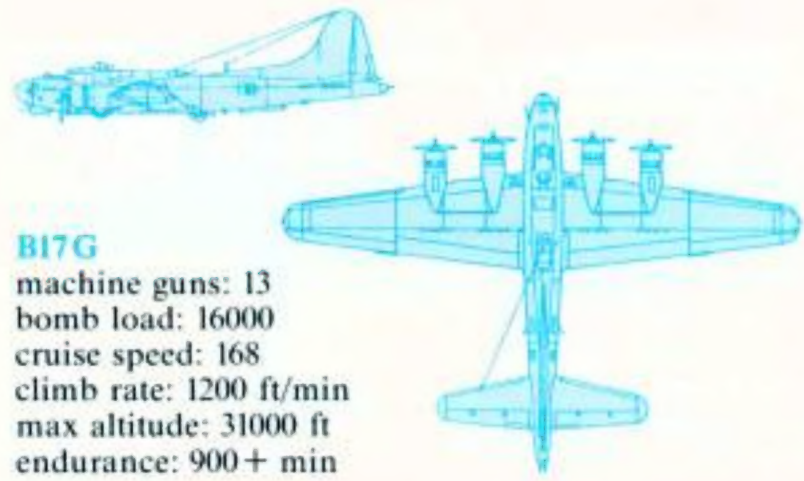
P51B
cannon: 4 x 50cal
bomb load: 2000
cruise speed: 253
climb rate: 2400 ft/min
max altitude: 42000 ft
endurance: 240 min



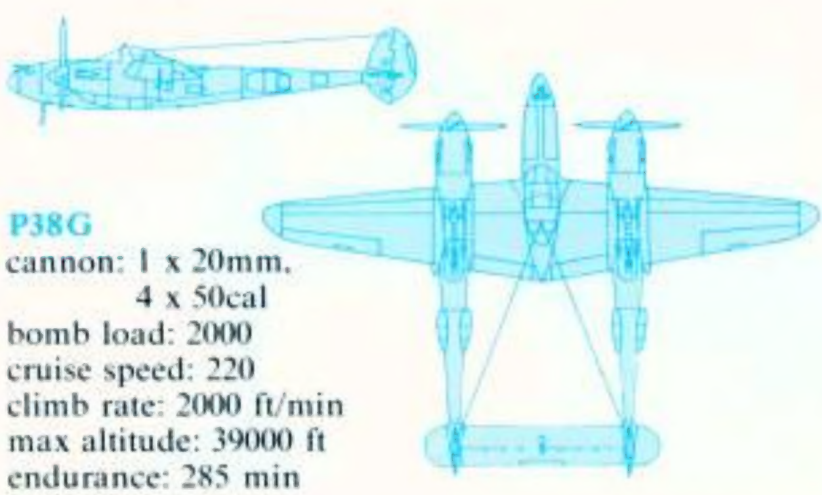
B17F
machine guns: 10
bomb load: 9000
cruise speed: 168
climb rate: 800 ft/min
max altitude: 33000 ft
endurance: 900+ min



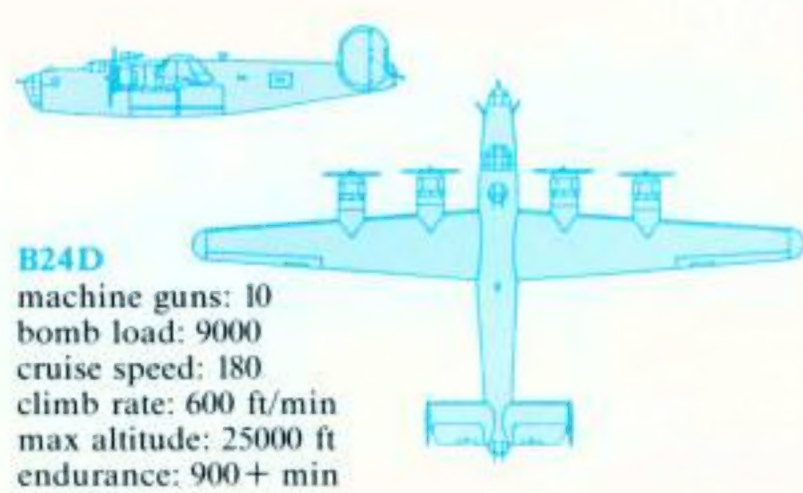
P51D
cannon: 6 x 50cal
bomb load: 2000
cruise speed: 260
climb rate: 2400 ft/min
max altitude: 42000 ft
endurance: 345 min



B17G
machine guns: 13
bomb load: 16000
cruise speed: 168
climb rate: 1200 ft/min
max altitude: 31000 ft
endurance: 900+ min

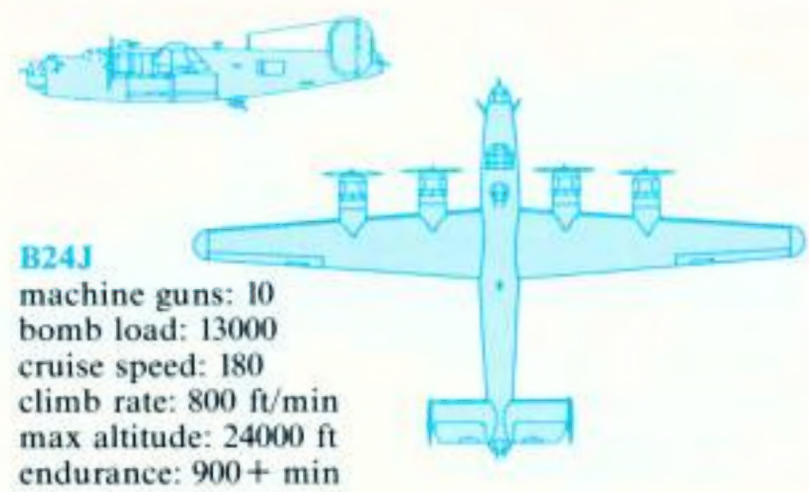


P38G
cannon: 1 x 20mm,
4 x 50cal
bomb load: 2000
cruise speed: 220
climb rate: 2000 ft/min
max altitude: 39000 ft
endurance: 285 min



B24D
machine guns: 10
bomb load: 9000
cruise speed: 180
climb rate: 600 ft/min
max altitude: 25000 ft
endurance: 900+ min

P38J
cannon: 1 x 20mm,
4 x 50cal
bomb load: 3000
cruise speed: 235
climb rate: 2600 ft/min
max altitude: 44000 ft
endurance: 375 min



B24J
machine guns: 10
bomb load: 13000
cruise speed: 180
climb rate: 800 ft/min
max altitude: 24000 ft
endurance: 900+ min

Aircraft Diagrams to Relative Scale

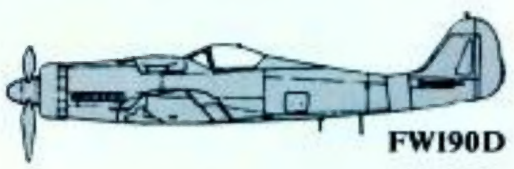

ME163B


ME109K


HE162A


ME109G


FW190A

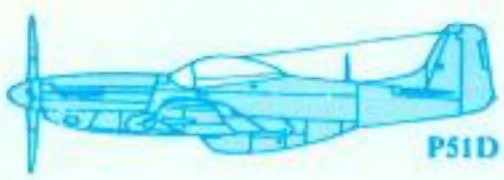

FW190D


P40E

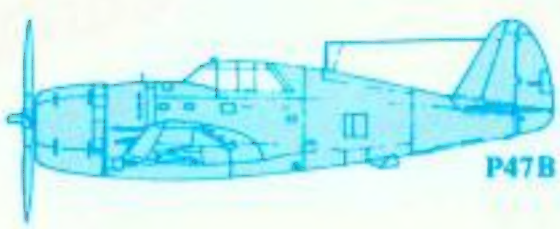

FW190F


TA152H


P51B


P51D

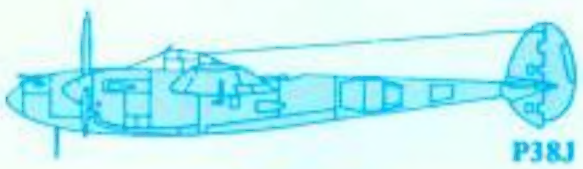

ME262A

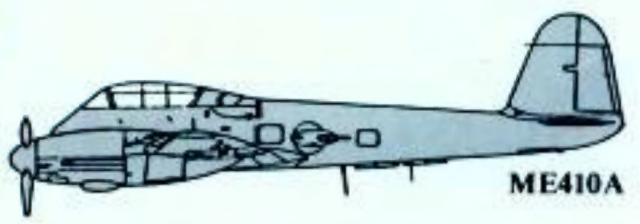

P47B


P47D

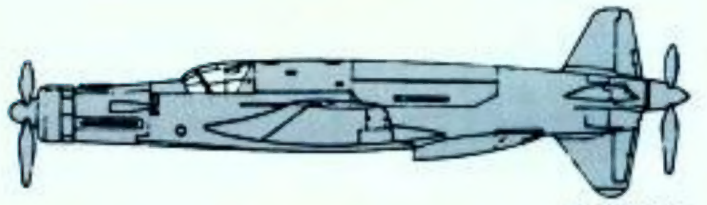

ME110G


P38G

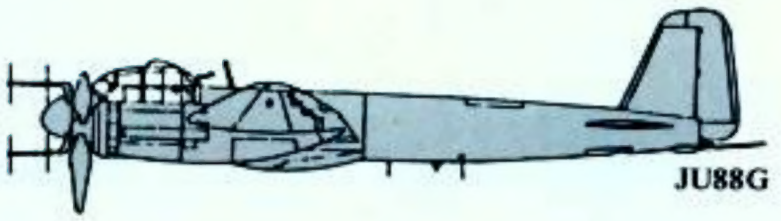

P38J


ME410A

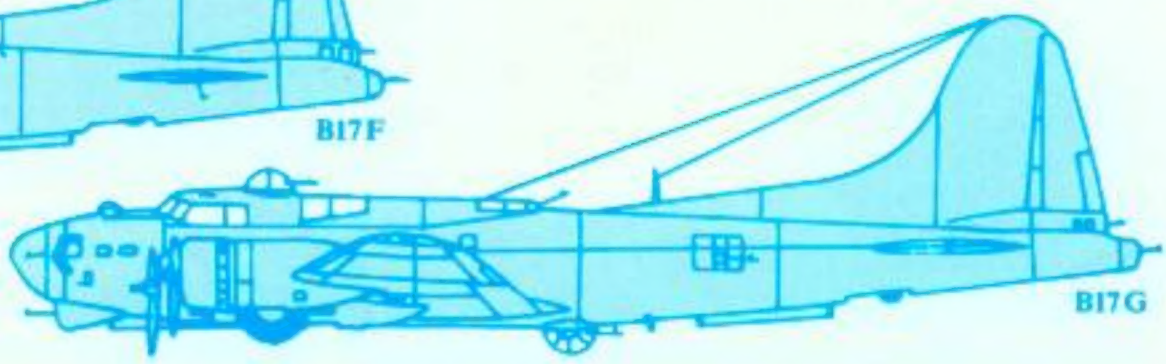

B24D


DO335A


B24J


JU88G


B17F


B17G

VICTORY POINT MATRIX

INDUSTRY	0-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90+
railyard	20	15	10	5	4	3	2	1	0
ball bearings	5	4	3	2	1	0	0	0	0
chemicals	5	4	3	2	1	0	0	0	0
oil	20	15	10	5	4	3	2	1	0
aviation gas	5	4	3	2	1	0	0	0	0
electric power	20	15	10	5	4	3	2	1	0
steel	5	4	3	2	1	0	0	0	0
rubber	5	4	3	2	1	0	0	0	0
U-boat	5	4	3	2	1	1	1	0	0
armaments*	30	25	20	15	10	5	3	1	0

* Divide armaments level by 10 before comparing to the damage matrix.

AIRCRAFT DATA

ID#	TYPE	CN	MV	DU	RR	SP	FU	MA	CL	C
1	ME109G	8	38	17	2	42	7	38	30	1
2	ME109K	7	50	17	2	46	6	41	41	1
3	FW190A	10	44	18	2	44	8	37	18	1
4	FW190D	6	48	19	2	46	8	39	28	1
5	FW190F	15	32	25	6	42	8	35	12	1
6	TA152H	13	48	24	2	50	10	49	48	1
7	DO335A	19	45	19	2	50	13	37	30	3
8	ME410A	13	22	20	6	40	17	33	18	2
9	ME110G	18	18	19	4	36	13	26	12	2
10	JU88G	12	18	23	4	36	21	32	12	2
11	ME262A	20	14	14	6	68	5	38	28	7
12	ME163B	10	40	10	0	96	2	40	40	8
13	HE162A	10	21	7	2	52	4	39	39	6

ID#	TYPE	CN	MV	DU	BL	SP	FU	MA	CL	C
14	P40E	6	37	14	1	40	10	30	18	1
15	P47B	8	44	22	2	40	10	42	18	1
16	P47D	8	46	23	3	40	12	40	24	1
17	P51B	4	46	18	2	42	16	42	24	1
18	P51D	6	48	18	2	42	23	42	24	1
19	P38G	6	36*	19	2	36	19	39	20	2
20	P38J	6	44*	23	3	40	25	44	26	2
21	B17F	9	0	42	9	28	90	33	8	4
22	B17G	10	0	43	16	28	90	31	12	4
23	B24D	9	0	32	9	30	90	25	6	4
24	B24J	9	0	33	13	30	90	24	8	4

* At altitudes greater than or equal to 20000 feet, the maneuverability ratings of the P38G and P38J are reduced to 27 and 33, respectively.

CN cannon rating; this is the defensive fire rating for heavy bombers
MV manueverability rating
DU durability rating
RR rocket rating
BL bomb load rating
SP speed ratings; miles per 10-minute pulse
FU operational fuel limit; fuel used before turning back
MA maximum altitude
CL climb rate; thousands of feet per 10-minute pulse
C aircraft class

CRITICAL INDUSTRY EFFECTS

CRITICAL IND.	DEPENDENT INDUSTRIES
Railyard	U-boat, Armaments, Aircraft
Ball Bearings	Armaments, Aircraft
Chemicals	Oil, AvGas, Rubber, Armaments
Electric Power	All Other Industries
Steel	U-boat, Armaments
Rubber	Armaments

INDUSTRY DEFENSE, REBUILD RATE, & OPTIMUM LEVEL

INDUSTRY TYPE	DEFENSE	REBUILD RATE	OPTIMUM LEVEL
railyard	6	8%	2
ball bearings	12	5%	5
chemicals	7	5%	6
oil	9	7%	5
aviation gas	9	7%	10
electric power	30	1%	3
steel	12	2%	8
rubber	10	5%	10
U-boat	13	3%	8
armaments	12	*4%	50
aircraft	10	*4%	50
V-weapon	10	4%	10

* The build chance for armaments will increase to 12% and the build chance for aircraft will increase to 20% starting 1/44.

USAAF REPLACEMENT SCHEDULE

AIRCRAFT TYPE	AIRCRAFT PER DAY	AIRCRAFT PER DAY	AIRCRAFT PER DAY
P40E	8/43 = 9	1/44 = 1	
P47B	8/43 = 3	9/43 = 1	
P47D	8/43 = 0	9/43 = 12	1/44 = 18
P51B	8/43 = 0	11/43 = 3	4/44 = 1
P51D	8/43 = 0	3/44 = 18	
P38G	8/43 = 9	12/43 = 1	
P38J	8/43 = 0	12/43 = 12	
B17F	8/43 = 1		
B17G	8/43 = 18		
B24D	8/43 = 3	10/43 = 1	
B24J	8/43 = 0	10/43 = 12	1/44 = 18

LUFTWAFFE AIRCRAFT PRODUCTION RATES

	AIRCRAFT PRODUCED PER 100 FACTORIES	LATEST POSSIBLE AVAILABILITY DATE
ME109G	15	8/43
ME109K	12	8/44
FW190A	10	8/43
FW190D	9	6/44
FW190F	8	8/43
TA152H	8	1/45
DO335A	7	3/45
ME410A	7	8/43
ME110G	8	8/43
JU88G	0*	8/43
ME262A	4	11/44
ME163B	6	9/44
HE162A	10	3/45

* Only a fraction of the production of this type of aircraft was available for daylight air defense of the Reich, so the German player will automatically receive one JU88G per day.